DSP VLSI Engine for
Electronic Linearization of Fiber Optic Links

Babak Daneshrad

Wireless Integrated Systems Research Group
UCLA Electrical Eng. Dept.
babak@ee.ucla.edu
(310) 825-7792

Approach: Apply LMS algorithm to linearization of optical links

Nonlinearity as a Series Expansion

- *Any function f(x) may be expressed using a series expansion*

$$f(x) = 1 + \alpha_1 x + \alpha_2 x^2 + \alpha_3 x^3 + \ldots$$

- *The function g(x) = $f^{-1}(x)$ can also be expressed using a series expansion:*

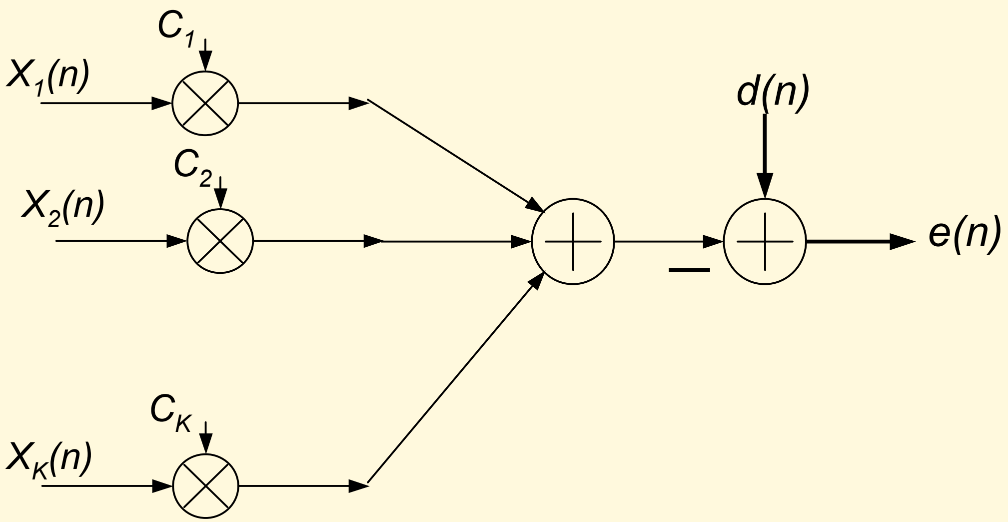
$$g(x) = 1 + \beta_1 x + \beta_2 x^2 + \beta_3 x^3 + \ldots$$

- *Thus the problem of linearizing the laser is translated into the problem of identifying the coefficients β*

- *In reality only a finite number of βs can be computed*
  - *Find the set of β such that the distortion (error) between $g_{finite}(x)$ and $g_{ideal}(x)$ is minimized*

LMS Basics

- ***The Least Mean Square (LMS) algorithm is a recursive solution to the minimum mean square error (MMSE) problem***
  - *Obtain optimum C_j to minimize $E\{e^2(n)\}$*



- ***LMS***
  - $C_j(n+1) = C_j(n) + \mu\, e(n)\, X_j(n)$ $\qquad j=1,2,\ldots,K$

Tasks and Progress

- **System simulations (in progress)**
  - Performance characterization as a function of:
    - LMS, sign-LMS, sign-sign-LMS
    - Number of harmonics generated
    - Signal precision
- **VLSI ASIC design and fabrication**
  - High speed architectures
  - Number representation
  - RTL level description
  - Place and route and back-end design
  - sign-off to foundry